Predictors of Earnings Risk with Machine Learning

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Abstract

This paper looks at the determinants of lifetime earnings risk under a Restricted Income Profile (RIP) model using traditional and machine learning methods such as lasso and SHAP values. The paper builds on the work of Drewianka and Oberg (2025) which uses a moment condition approach derive a parameter that captures permanent income risk. The paper finds that education and age are important in explaining lifetime earnings risk. The paper also finds that macroeconomic variables such as probability of recession and real GDP growth are important and along with state controls may further imply a role of government policy. Finally, the paper finds that occupation controls are important while industry controls do not appear to play a strong role.

Keywords: machine learning, restricted income profile, earnings instability, risk
JEL Codes: D8, J0, D3

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1 Introduction

2 Data and Model

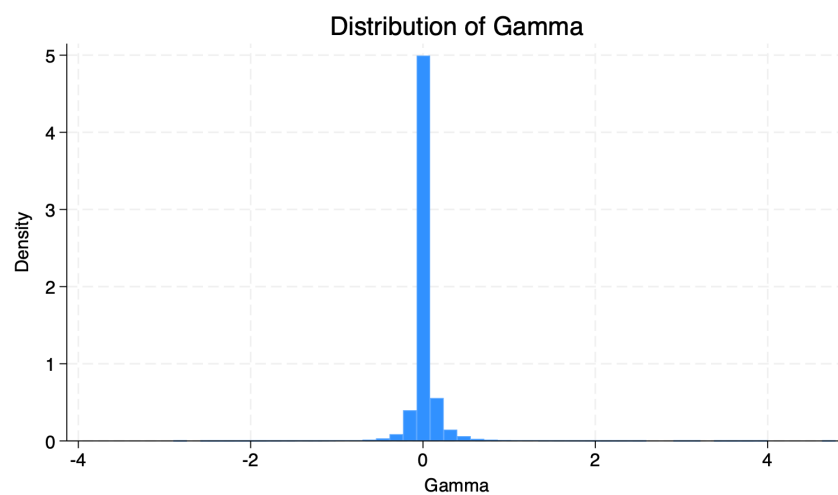# 3 Empirical Strategy

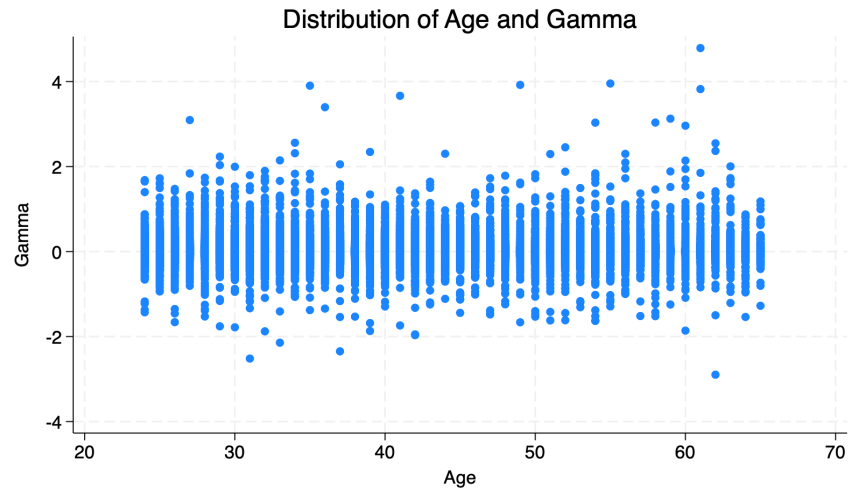# 4 Results

5 Conclusion

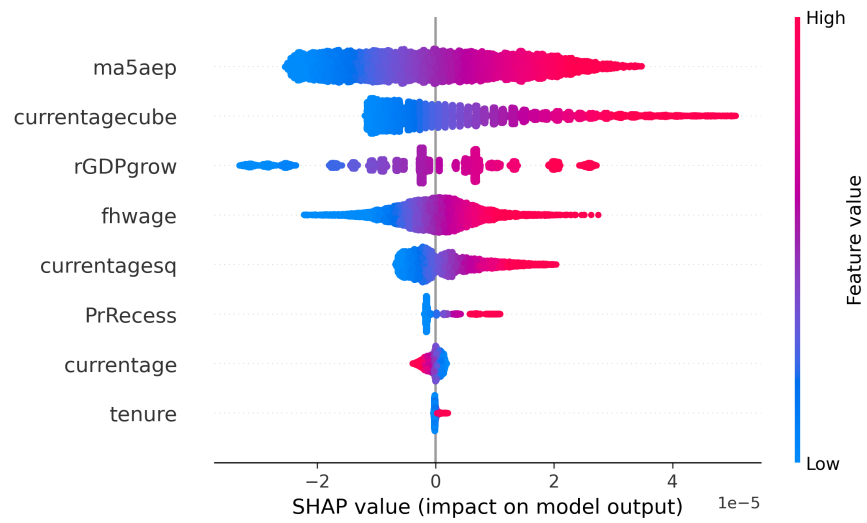Figure 1: Distribution of Gamma

Figure 2: Scatterplot of Age vs. Gamma

Figure 3: SHAP Summary Plot for Gamma

Table 1: Gamma Regressions: OLS Results

	(1) Gamma	(2) Gamma	(3) Gamma	(4) Gamma	(5) Gamma
Less than High School	-0.0115***	-0.0107***	-0.0117***	-0.0109***	-0.0117***
	(0.00215)	(0.00232)	(0.00242)	(0.00253)	(0.00255)
High School Graduate	-0.00918***	-0.00854***	-0.00902***	-0.00812***	-0.00850***
	(0.00144)	(0.00149)	(0.00158)	(0.00171)	(0.00173)
Some College	-0.00746***	-0.00681***	-0.00736***	-0.00674***	-0.00695***
	(0.00170)	(0.00172)	(0.00177)	(0.00184)	(0.00185)
Probability of Recession	0.0000422	-0.0104	-0.0000953	-0.0000817	-0.0000292
	(0.0000437)	(0.0179)	(51.52)	(51.50)	(51.49)
Real GDP growth rate	0.000600	-0.00432	-0.0000211	-0.000186	-0.000626
	(0.000400)	(0.00325)	(3.981)	(3.979)	(3.979)
5-year moving average of AEP	0.0000636*	0.0000629	0.0000374	0.0000766*	0.0000688
	(0.0000295)	(0.0000322)	(0.0000340)	(0.0000347)	(0.0000356)
Out of Labor Force	-0.00430	-0.00410	-0.00471	-0.00461	-0.00474
	(0.00535)	(0.00536)	(0.00573)	(0.00572)	(0.00572)
Tenure	-0.0000438	-0.0000336	0.0000277	0.00000375	0.0000156
	(0.0000888)	(0.0000963)	(0.0000981)	(0.0000984)	(0.0000987)
Age	0.00592*	0.00650*	0.00679*	0.00679*	0.00671*
	(0.00269)	(0.00273)	(0.00274)	(0.00274)	(0.00274)
Age Squared	-0.000170**	-0.000193**	-0.000196**	-0.000197**	-0.000194**
	(0.0000651)	(0.0000659)	(0.0000662)	(0.0000662)	(0.0000663)
Age Cubed	0.00000153**	0.00000172***	0.00000173***	0.00000173***	0.00000171***
	(0.000000509)	(0.000000515)	(0.000000517)	(0.000000518)	(0.000000518)
State FE	No	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	Yes	Yes
Race FE	No	Yes	Yes	Yes	Yes
Cohort FE	No	Yes	Yes	Yes	Yes
Occupation FE	No	No	No	Yes	Yes
Industry FE	No	No	Yes	No	Yes
R-squared	0.001	0.002	0.003	0.005	0.006
N	82357	82333	81556	81556	81556

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2: Gamma Regressions: Stepwise Selection Results

	(1)	(2)	(3)	(4)	(5)
	Gamma	Gamma	Gamma	Gamma	Gamma
Less than High School	-0.0110***	-0.0110***	-0.0101***	-0.0108***	-0.0110***
	(0.00211)	(0.00211)	(0.00205)	(0.00234)	(0.00236)
High School Graduate	-0.00904***	-0.00905***	-0.00840***	-0.00829***	-0.00834***
	(0.00143)	(0.00143)	(0.00143)	(0.00166)	(0.00168)
Some College	-0.00740***	-0.00740***	-0.00731***	-0.00723***	-0.00725***
	(0.00169)	(0.00169)	(0.00172)	(0.00182)	(0.00183)
Age	0.00571*	0.00568*		0.00594*	0.00566*
	(0.00268)	(0.00268)		(0.00270)	(0.00270)
Age Cubed	0.00000150**	0.00000149**	0.000000439***	0.00000150**	0.00000143**
	(0.000000508)	(0.000000508)	(8.71e-08)	(0.000000511)	(0.000000511)
5-year moving average of AEP	0.0000579*	0.0000577*		0.0000788*	0.0000732*
	(0.0000286)	(0.0000286)		(0.0000316)	(0.0000324)
Age Squared	-0.000165*	-0.000165*	-0.0000282***	-0.000168*	-0.000161*
	(0.0000650)	(0.0000650)	(0.00000578)	(0.0000654)	(0.0000654)
Constant	-0.0391	-0.0387	0.0395***	-0.0414	-0.0380
	(0.0358)	(0.0358)	(0.00358)	(0.0360)	(0.0360)
State FE					
Year FE					
Race FE					
Cohort FE					
Occupation FE				✓	✓
Industry FE			✓		✓
State FE Available	No	Yes	Yes	Yes	Yes
Year FE Available	No	Yes	Yes	Yes	Yes
Race FE Available	No	Yes	Yes	Yes	Yes
Cohort FE Available	No	Yes	Yes	Yes	Yes
Occupation FE Available	No	No	No	Yes	Yes
Industry FE Available	No	No	Yes	No	Yes
R-squared	0.001	0.001	0.002	0.003	0.004
N	82357	82333	81556	81556	81556

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3: Gamma Regressions: Lasso Selection Results

	No Controls	No Occ/Ind	No Occ	No Ind	All Controls
EDU1	2	3	3	2	2
EDU2	1	2	2	2	2
EDU3	3	4	4	4	3
OLF	9	9	8	7	6
PrRecess	10				
currentage	8	7	6	5	4
currentagecube	4	8	7	6	5
currentagesq	11	10	10	9	8
ma5aep	5	5	5	3	3
rGDPgrow	6				
tenure	7	6	9	8	7
State FE	No	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	Yes	Yes
Race FE	No	Yes	Yes	Yes	Yes
Cohort FE	No	Yes	Yes	Yes	Yes
Occupation FE	No	No	No	Yes	Yes
Industry FE	No	No	Yes	No	Yes

Table 4: Gamma Regressions: Lasso Industry Selection Results

Industry	LASSO Order	SHAP Order
Other Services	1	1
Priv. Househld	1	29
	1	
Legal Services	2	5
Public Administration	3	3
Financial Inst	3	16
Construction	3	23
Health Service	4	6
Clothing/Text	4	14
Mechanical Eng	5	19
Energy/Water	6	11
Agric.,Forestry	7	13
Chemicals	7	15
Educ./Sport	7	17
Retail	8	2
Earth/Clay/Stone	8	20
Social Security	9	21
Volunt./Church	9	24
Wholesale	10	4
Iron/Steel	10	18
Electrical Eng	10	22
Constr. Relate	11	10
Synthetics	11	25
Mining	11	27
Fisheries	12	32
Wood/Paper/Print	13	9
Not Applicable	14	
Other Trans.	15	28
Restaurants	16	12
Train System	16	26
Food Industry	17	7
Insurance	17	31
Service Indust	18	30
Postal System		8

Table 5: Gamma Regressions: Lasso Occupation Selection Results

Occupation	LASSO Order	SHAP Order
Dr./Dentist/Vet	1	11
Insurance Rep.	2	9
Transp. Attend	2	60
	3	
Priv.Bus.Leadr	4	1
Author	4	25
Aero/MarineEngr	4	33
Lumbrman/Axman	5	43
Vendor	6	4
Painter	6	36
Hair Stylist	6	47
Janitor	7	6
Legislator	7	13
Chemist	7	52
Farm Manager	8	10
Music/Perform	8	53
Buyer	8	71
Labor/Craftsmn	9	29
Jewelry Maker	10	63
Mathematician	11	28
Tel. Operator	11	62
Prof. Athlete	11	70
Miner	12	50
Educator	13	5
Machine Fitter	13	34
Stone Cutter	13	72
SecurityServic	14	2
BusinessManagr	14	15
ComputerOperat	14	58
Cook/Waiter	15	32
Fisher/Hunter	15	69
Not Applicable	15	
Agriculturladm	16	45
Eng.Tech.Expert	17	48
ChemicalWorker	17	49
Conductor	17	74
Transport.Oper	18	3
Stenographer	18	66
Architect/Engineer	19	19
Economist	19	40
Tech.Salespers	19	59
Lawyer	20	12
Soldier	20	23
Office Manager	21	65
Salesperson	21	77
Ofc.Worker Etc	22	24
Administrator	22	73

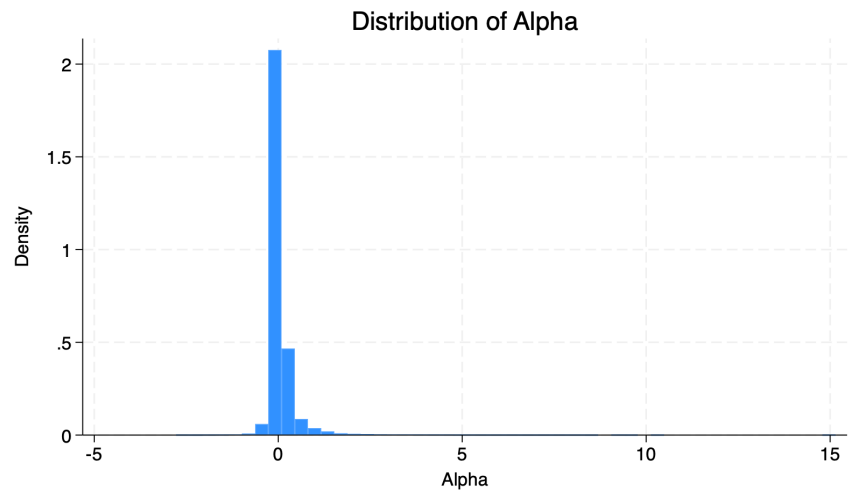Figure 4: Distribution of Alpha

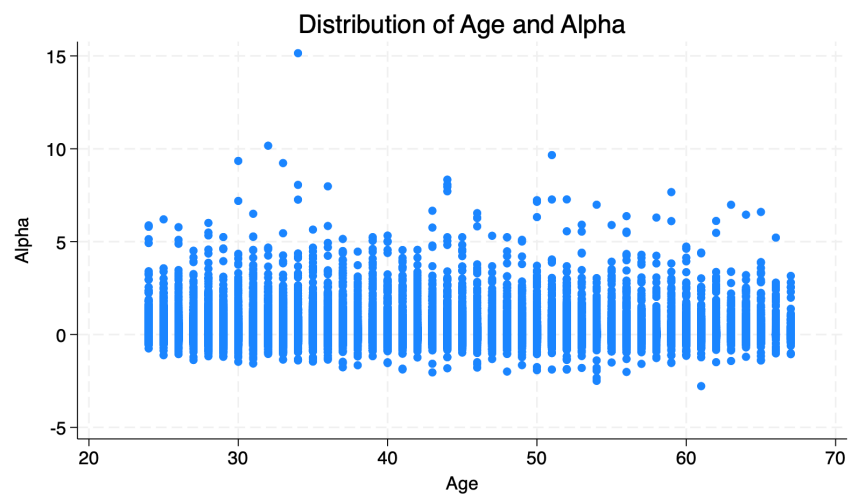Figure 5: Scatterplot of Age vs. Alpha

Table 6: Alpha Regressions: OLS Results

	(1) Alpha	(2) Alpha	(3) Alpha	(4) Alpha	(5) Alpha
Less than High School	-0.0268***	-0.0240***	-0.0308***	-0.0278***	-0.0301***
	(0.00451)	(0.00487)	(0.00508)	(0.00531)	(0.00535)
High School Graduate	-0.0131***	-0.0129***	-0.0136***	-0.00909*	-0.0104**
	(0.00309)	(0.00320)	(0.00340)	(0.00368)	(0.00372)
Some College	-0.00240	-0.00321	-0.00223	0.00135	0.000562
	(0.00366)	(0.00370)	(0.00384)	(0.00398)	(0.00401)
Probability of Recession	-0.0000420	-0.138*	-0.113	-0.112	-0.113
	(0.0000929)	(0.0554)	(0.0723)	(0.0723)	(0.0722)
Real GDP growth rate	-0.00144	0.000541	-0.00107	-0.00287	-0.00359
	(0.000855)	(0.00633)	(0.00713)	(0.00710)	(0.00714)
5-year moving average of AEP	0.00127***	0.00138***	0.00103***	0.00111***	0.00106***
	(0.0000616)	(0.0000669)	(0.0000712)	(0.0000726)	(0.0000745)
Out of Labor Force	0.113***	0.111***	0.0518***	0.0521***	0.0517***
	(0.0101)	(0.0101)	(0.0111)	(0.0111)	(0.0111)
Tenure	-0.000698***	-0.00000130	0.000135	0.0000259	0.0000861
	(0.000185)	(0.000202)	(0.000207)	(0.000208)	(0.000208)
Age	0.0165**	0.0183***	0.0175***	0.0182***	0.0173**
	(0.00520)	(0.00526)	(0.00530)	(0.00530)	(0.00530)
Age Squared	-0.000398**	-0.000451***	-0.000431***	-0.000452***	-0.000427***
	(0.000124)	(0.000125)	(0.000126)	(0.000126)	(0.000126)
Age Cubed	0.00000324***	0.00000371***	0.00000356***	0.00000374***	0.00000353***
	(0.000000947)	(0.000000955)	(0.000000963)	(0.000000963)	(0.000000964)
State FE	No	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	Yes	Yes
Race FE	No	Yes	Yes	Yes	Yes
Cohort FE	No	Yes	Yes	Yes	Yes
Occupation FE	No	No	No	Yes	Yes
Industry FE	No	No	Yes	No	Yes
R-squared	0.008	0.013	0.020	0.021	0.023
N	102946	102910	100781	100781	100781

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: Alpha Regressions: Stepwise Selection Results

	(1) Alpha	(2) Alpha	(3) Alpha	(4) Alpha	(5) Alpha
Less than High School	-0.0261***	-0.0204***	-0.0259***	-0.0259***	-0.0272***
	(0.00418)	(0.00450)	(0.00464)	(0.00477)	(0.00480)
High School Graduate	-0.0122***	-0.0108***	-0.0107***	-0.00852**	-0.00913**
	(0.00271)	(0.00278)	(0.00289)	(0.00304)	(0.00306)
Age Squared	-0.000401**	-0.000394**	-0.000336**	-0.000384**	-0.000351**
	(0.000124)	(0.000124)	(0.000125)	(0.000125)	(0.000125)
Age Cubed	0.00000326***	0.00000327***	0.00000287**	0.00000321***	0.00000296**
	(0.000000947)	(0.000000950)	(0.000000959)	(0.000000959)	(0.000000959)
Real GDP growth rate	-0.00115*				
	(0.000541)				
5-year moving average of AEP	0.00127***	0.00135***	0.00106***	0.00111***	0.00107***
	(0.0000601)	(0.0000650)	(0.0000689)	(0.0000711)	(0.0000728)
Out of Labor Force	0.113***	0.112***	0.0535***	0.0541***	0.0535***
	(0.0101)	(0.0101)	(0.0111)	(0.0111)	(0.0111)
Tenure	-0.000704***				
	(0.000185)				
Age	0.0167**	0.0159**	0.0132*	0.0153**	0.0140**
	(0.00519)	(0.00523)	(0.00527)	(0.00527)	(0.00527)
Constant	-0.190**	-0.157	-0.102	-0.117	-0.105
	(0.0704)	(0.0825)	(0.0831)	(0.0831)	(0.0831)
State FE		✓	✓	✓	✓
Year FE		✓	✓	✓	✓
Race FE		✓	✓	✓	✓
Cohort FE					
Occupation FE				✓	✓
Industry FE			✓		✓
State FE Available	No	Yes	Yes	Yes	Yes
Year FE Available	No	Yes	Yes	Yes	Yes
Race FE Available	No	Yes	Yes	Yes	Yes
Cohort FE Available	No	Yes	Yes	Yes	Yes
Occupation FE Available	No	No	No	Yes	Yes
Industry FE Available	No	No	Yes	No	Yes
R-squared	0.008	0.012	0.018	0.021	0.022
N	102946	102910	100781	100781	100781

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8: Alpha Regressions: Lasso Selection Results

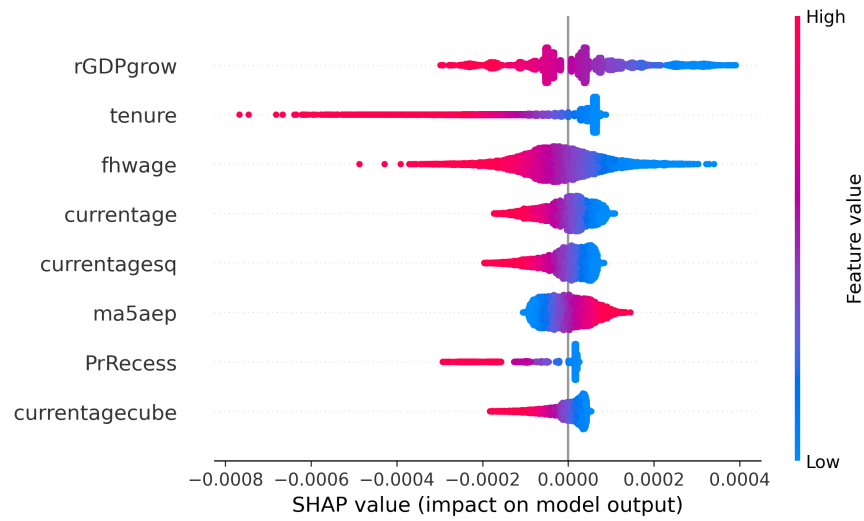|	No Controls	No Occ/Ind	No Occ	No Ind	All Controls
EDU1	4	5	4	4	4
EDU2	5	6	6	7	7
EDU3	7	7	8	6	6
OLF	2	3	3	3	3
PrRecess	8				
currentage		9	9	8	9
currentagecube	3	4	5	5	5
currentagesq		10	10	9	10
ma5aep	1	2	2	2	2
rGDPgrow	6				
tenure	4	8	7	10	8
State FE	No	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	Yes	Yes
Race FE	No	Yes	Yes	Yes	Yes
Cohort FE	No	Yes	Yes	Yes	Yes
Occupation FE	No	No	No	Yes	Yes
Industry FE	No	No	Yes	No	Yes

Figure 6: SHAP Summary Plot for Alpha

Table 9: Alpha Regressions: Lasso Industry Selection Results

Industry	LASSO Order	SHAP Order
Not Applicable	1	
Agric.,Forestry	2	2
Fisheries	3	29
	3	
Mechanical Eng	4	1
Public Administration	4	3
Construction	5	13
Legal Services	5	23
Other Services	6	22
Energy/Water	7	15
Constr. Relate	8	31
Clothing/Text	9	16
Synthetics	9	19
Service Indust	10	27
Iron/Steel	11	7
Postal System	12	10
Health Service	13	8
Food Industry	14	17
Chemicals	14	20
Train System	14	24
Educ./Sport	15	9
Retail	16	5
Electrical Eng	16	14
Other Trans.	17	11
Wood/Paper/Print	18	4
Restaurants	18	28
Priv. Househld	18	32
Financial Inst	19	12
Earth/Clay/Stone	20	26
Volunt./Church	21	21
Social Security	22	30
Insurance	23	18
Wholesale		6
Mining		25

Table 10: Alpha Regressions: Lasso Occupation Selection Results

Occupation	LASSO Order	SHAP Order
Not Applicable	1	
Farm Manager	2	1
Fisher/Hunter	3	42
	4	
Mathematician	5	4
Insurance Rep.	6	18
Architect/Engineer	7	8
Inspector	8	9
Bricklay/Carpt	8	41
Agriculturladm	8	44
Priv.Bus.Leadr	9	13
Prof. Athlete	9	55
Music/Perform	10	39
Mailman	11	5
BusinessManagr	11	10
Eng.Tech.Expert	12	15
ComputerOperat	12	40
Hair Stylist	12	74
Ofc.Worker Etc	13	11
Cook/Waiter	13	28
Scientist	14	21
Chemist	15	48
Tech.Salespers	15	59
Economist	15	75
Office Manager	16	32
Aero/MarineEngr	16	38
Sculptr/Paintr	16	58
Printer Etc.	17	25
Rest./StoreMgr	17	52
Jewelry Maker	17	66
Soldier	18	29
Tool/Die Maker	19	6
Administrator	19	36
Stenographer	19	62
ChemicalWorker	20	46
Spinner/Weaver	20	47
Buyer	20	50
Machine Fitter	21	3
Electr. Enginr	21	17
RelatMedicalJob	21	27
Convey. Oper.	22	7
Glazier	23	63
Miner	24	49
Lawyer	25	45
Shoemaker	25	64
Cleric	26	33
Dr./Dentist/Vet	26	37

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